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Shiras moose occupying the Clearwater River drainage of Northcentral Idaho inhabitat an area of deep snow, dense conifer cover, and steep terrain without any willow dominated riparian zones. Winter ranges are characterized by double canopy, old growth forests which intercept significant amounts of snow and also provide palatable evergreen forage, either Pacific yew or subalpine fir. These winter ranges are subject to logging, which appreciably reduces their value to moose. Timber harvest using partial cutting systems and group selection cuts are recommended to retain sufficient overstory cover to maintain moose habitat. Illegal moose harvest in this region is at least equivalent to the legal harvest, so road closure programs are needed in areas moose are using to reduce the illegal take.

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Introduction

In an earlier review of Shiras moose (*Alces a. shirasi*) winter habitats (Peek 1974), emphasis was given to riparian communities dominated by willow (*Salix* spp.) as the most common winter range. Stevens (1970) described a winter range in south central Montana where a mixture of willow communities, aspen (*Populus tremuloides*), and conifers, primarily Douglas fir (*Pseudotsuga menziesii*), were used. Peek (1974) reported that subalpine fir (*Abies lasiocarpa*)-Engelmann spruce (*Picea engelmanni*) stands at higher elevation supported low density moose populations in winter in some areas.

Investigations of moose populations and habitats in central Idaho have further elaborated on use of areas where willow is not a component of the winter range. The habitats which appear critical to moose are subject to modification by logging and thus comprise an entirely different set of management problems than occur where moose occupy non-commerical forest. The effects of logging practices on these moose populations has become an increasingly important issue for land and wildlife man-

agers in this region. On the Nezperce National Forest, about 5661 ha or 19% of the original or potential moose winter range of 29905 ha has already been logged without regard to moose.

This review describes the habitats used by two moose populations in central Idaho and proposed forest management for these habitats which can retain or enhance their value as moose habitat. Information on population status is also included.

Habitats

Moose habitat in central Idaho is typically densely forested, steep terrain. Canyons are generally narrow and riparian vegetation is consequently very limited. Forests used by moose occur primarily in the subalpine fir and grand fir (*Abies grandis*) vegetative series (Cooper et al. 1983). In the South Fork of the Clearwater River drainage, four habitat types (Daubenmire, 1952) are used: grand fir/goldthread (*Coptis occidentalis*), grand fir/clintonia (*Clintonia uniflora*), grand fir/ginger (*Asarum caudatum*), and subalpine fir/beargrass (*Xerophyllum tenax*). Pacific yew (*Taxus brevifolia*) occurs as a major subdominant in old growth forest within the grand fir/ginger habitat type, occurring as a subcanopy beneath the taller firs and creating essentially a double-canopied forest overstory. Douglas fir, western larch (*Larix occidentalis*), lodgepole pine (*Pinus contorta*), and Engelmann spruce occur as seral conifer species and may dominate successional sequences in various proportions.

Shrub species that dominate understory vegetation in these habitat types include menziesia (*Menziesia ferruginea*), huckleberries (*Vaccinium membranaceum, V. globulare, V. scoparium*), honeysuckle (*Lonicera utahensis*), and snowberry (*Symphoricarpos albus*).

Elevations in this area range from 600 m to 2700 m with grand fir occurring below 1800 m and subalpine fir above 1800 m.

The Lochsa River-Selway River moose population typically occupies the subalpine fir series, including subalpine fir/clintonia, subalpine fir/menziesia habitat types. Subalpine fir, Engelmann spruce, western larch, lodgepole pine, and Douglas fir are common seral species which may dominate current overstories. Understory species may include subalpine fir, Engelmann spruce, lodgepole pine, menziesia, and huckleberries. Elevations of the series range from approximately 1200 m to 2100 m in this region, with lowest elevations in the Lochsa drainage at 1100 m at Powell, Idaho, where moose are most common.

Climate in this region is influenced by the Pacific Ocean and northern regimes. Winters generally bring deep snow and low temperatures, while summers are dry and hot. Average minimum and maximum temperatures at Elk City are −3 and 13°C, respectively. Annual precipitation of 85 cm over a 20-year period exists at Elk City, and snow depths over 100 cm are not uncommon from December through March.

The combination of deep snow, dense conifer cover, absence of willow, and steep terrain collectively distinguishes this moose habitat as a different situation than previously described.

Populations

Shiras moose are native to central Idaho, their presence having been recorded since the mid-1800s (Pierce 1983). Population levels have fluctuated noticeably although no efforts to measure them have occurred until recently. A census of the moose population in the Elk City area produced an estimate of 0.90±0.44 ($\bar{x} \pm$ SD) moose/km^2 over a 481 km^2 area. A bull:cow:calf ratio was also judged low. Eight of nine radio-collared cows calved in consecutive years, two in three consecutive years. Five sets of twins were observed among 33 different cow/calf groups during the study period. Preliminary information from the Lochsa River drainage suggested a comparable population level with similar sex and age ratios (Schlegel 1983). These areas are supporting abundant and productive moose populations.

Populations are hunted under a limited permit system. A lottery is used to select hunters. In 1983, 80 permits for antlered bulls were issued, and 67 bulls were taken in the central Idaho region (McNeill 1983).

Habitat Use Patterns

The most prominent features of wintering areas used by moose in this region are the double-canopy forests dominated by conifers. In the South Fork of the Clearwater area, mature forests dominated by grand fir, with a secondary canopy of Pacific yew, were most used (Pierce and Peek 1984). The overstory densities of 272 trees/ha were less than average values (395 trees/ha) for randomly sampled stands in these communities. However the canopy coverage of Pacific yew (34%) was much higher than for randomly sampled stands (18%). Additionally, coverage of menziesia, mountain maple (*Acer glabrum*), and serviceberry (*Amelanchier alnifolia*) was higher in stands used by moose as compared to randomly sampled stands. These shrubs, along with Pacific yew, provided forage in stands that were available during deep-snow periods (Pierce 1984).

Moose were not observed to use logged-over forest significantly, even when available. Preferred forage species were least common in clearcuts and occurred most frequently under old growth timber (Pierce 1984). Moose occasionally used lakes and ponds during summer. Substantial variability in use of cover types occurred from June through September.

In the upper Lochsa River area, 120 radio locations of seven moose indicated that subalpine fir stands with 55% overstory closure with canopies of subalpine fir, Engelmann spruce, and lodgepole pine were major wintering areas. Riparian zones at 1460 m elevation covered by these double-canopied stands were considered important moose habitats

Habitats used in winter in both the Lochsa and South Fork regions intercepted significant quantities of snow because of the double-canopied overstories (Pierce and Peek 1984). Additionally, subalpine fir, Douglas fir, and Pacific yew are palatable forages in these areas. Thus moose were wintering in stands where a combination of food and cover was available during the severe winter periods characteristic of this area.

Habitat Management

Habitat management to create productive stands of seral browse species will not provide adequate moose habitat in these areas. Rather, the situation must be viewed as a problem of retention of mature forest with a subcanopy of palatable coniferous species and shade-tolerant deciduous shrubs. Since much of the area in which moose winter is commercially valuable forest, there is a strong need to integrate moose habitat preferences with silvicultural prescriptions. The option of precluding logging in the most important wintering areas, or at least delaying logging in these areas, is a valid interim recommendation. However, these stands are subject to insect infestations, and mortality from other pathogens which may over time adversely alter their value as moose habitat. Eventually, management to retain these areas in a form that moose will use must be applied. Provisions to monitor moose use of logged areas should be made.

Communities containing a subcanopy of Pacific yew which are over 90 years of age will provide moose winter range in this region. Stands over 20 ha in size and on slopes of less than 25 % are subject to management by traditional tractor logging methods. Stands on steeper terrain require more expensive slash disposal methods to retain Pacific yew and stands smaller than 20 ha must be combined with adjacent areas to become economical for logging at present. These communities occur in elevational bands or localized drainages, so uncut corridors need to be provided to prevent isolation of winter range units. Approximately half of the stands are on steep slopes over 25 %.

Management should be designed to retain a 30–50 % canopy coverage of overstory trees (100–170 trees/ha) and 50–60 % canopy coverage of the yew subcanopy within a logging unit 90 years after treating the stands. Management may be based on 30 year age classes, with rotations of 210 years. No more than about 45 % of the total area to be managed as moose winter range should be in an age class younger than the 90-year minimum after one complete 210 year rotation, and no more than 14 % of the winter range should be logged in any 30-year period.

Since coniferous overstory must be regenerated on logged areas, the group selection method which eliminates shade from small units within a system and provides an adequate seed bed for seedling establishment is preferred. Cutting blocks with logging units should be 4–8 ha with the smaller size preferred.

Pacific yew is extremely susceptible to mortality from fire (Crawford 1983), so broadcast burning as a shade removal and soil preparation technique is not satisfactory when a yew subcanopy is to be retained. Conversely, tractor activity which is necessary to pile slash may damage yew left within a cutting unit unless care is taken to minimize this source of mortality.

In the Lochsa River, where subalpine fir comprises the understory rather than Pacific yew, group selection cuts of similar size are satisfactory (G. Nordby, pers. comm., 11 May 1984). Areas should be logged in winter over snow to minimize soil disturbance. Light broadcast burning may be used to reduce slash and prepare sites. Natural regeneration of subalpine fir may be relied upon, but some planting of Engelmann spruce may be required. Rotation ages over 100 years are needed on upland sites.

Riparian zone management may require partial cutting systems as described by Alexander and Edminster (1977). Single tree selection in areas where Engelmann spruce predominates may be economically viable, and may also be needed where soil and vegetation disturbance in riparian zones and steep slopes are involved. A 150-year rotation in riparian zones is indicated.

Management means that access to moose winter range will increase, along with the potential for increased illegal harvest. In this region, the illegal kill is at least equal to the legal harvest and has increased as access has increased (Pierce 1983). Any plans to manage moose habitat must involve a road management program which involves closing roads when moose are using the areas.

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